Interpretation of the Empirical Results

Market Power in Grower and Retail Markets

As we emphasize in developing our method of analysis, the ability of any approach to separate the use of market power from changes in supply or demand relies upon an accurate accounting for all other factors that may contribute to variation in both grower and retail prices. However, despite the fact that we do estimate models of demand and supply for each commodity, the specific results of these models is not of central interest here, so they are reported in the technical appendix and fully discussed elsewhere (Richards and Patterson, 2001). This section, therefore, provides an explanation and interpretation of our empirical results specifically as they relate to the cooperative price setting behavior by retailers in commodity and retail produce markets. In order to preserve the anonymity of individual retail chains, we present our results in terms of average indices of pricing or market power for each of the six regional markets, for each commodity.

Perhaps more important than these individual index estimates, however, are estimates of the impact of market volume on retailers' price setting ability. Rather than simply describe symptoms of any behavioral problems that may exist in retail produce markets, these estimates provide critical insights into their underlying cause. Specifically, we are able to assess whether or not retailers possess a critical facilitating mechanism through which they may be able to tacitly cooperate to set imperfectly competitive prices. In doing so, we interpret the results commodity by commodity, beginning with Washington Red Delicious apples.

Washington Apples

Prior to interpreting the specific results of our statistical tests on the ability of retailers to set prices, we must first establish the legitimacy of our overall approach. To do so, we conduct tests of whether or not the retail-farm margin data are consistent with a world in which market rivals go through periods of cooperation with one another followed by periods of punishment by reversion to more competitive pricing. Although no statistical tests can claim to provide entirely conclusive results, we find strong statistical evidence in support of our view of how retailers set buying and selling prices for apples. Specifically, we find that margins appear to follow a pattern wherein they fall into either of two regimes—one where they are relatively narrow, where growers or consumers receive competitive prices, and others in which they widen significantly, where growers or consumers face noncompetitive prices. This pattern could arise under a number of different circumstances, but it is very plausibly explained by our theory of retailer pricing behavior.

Perhaps stronger support for this theory lies in the impact of apple sales volume on the index of market power. According to our hypothesis, observed pricing power by retailers should fall with sales volume due to their need to secure sufficient supply to meet higher quantities demanded under periodic price-promotion programs. Our statistical evidence is not as strong on this point, but we do find this effect in a majority of our retailer/market pairs. Clearly, because there is some diversity in marketing strategies among major retailers, there are some that do not follow this generic pricing strategy. For example, it is well known that one major retailer follows instead an everyday low price (EDLP) strategy, irrespective of its rivals' pricing behavior. Perhaps for this reason, it is clear that the ability to price strategically is not uniform across markets.

Apple Commodity Market

While non-uniform, there does appear to be a relatively consistent pattern of price setting power in both commodity and retail markets that is, in many cases, significant both in an economic and in a statistical sense. Specifically, in Albany we find that retailers, on average, exercise a significant degree of power in both their buying and selling activities. Given that the scale of this index is bound between zero (competitive pricing)[8] and one (perfect pricing coordination) on the buying side and zero and the number of sellers, N, on the selling side, the degree of buying power is considerably higher than what we would observe in perfect competition.[9]

The index of commodity buyer market power varies from 0.144 in Dallas to 0.765 in Los Angeles (fig. 1). (The technical appendix reports all the estimated parameters for each region and chain). Interpreted purely as an

[8] Technically, this index approaches $1/N$ at the lower bound, where N is the number of retail buyers; this clearly goes to zero as N becomes large.

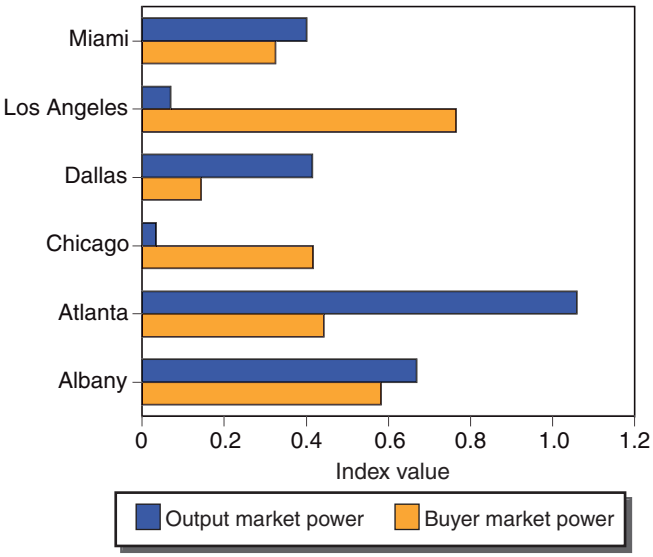
[9] This range applies to the absolute value, or ignoring negative signs, for the estimated index. The figures present negative values for buying-power indices for illustrative purposes only.

index, the degree of buying power exercised by retailers in the apple market appears to be only moderate, averaging 0.446 over all sample markets. This means that fully 44 percent of the difference between retail and shipping-point prices is explained by buying power - certainly not perfectly cooperative levels of distortion, but not consistent with perfect competition either. These results are not statistical anomalies as 80 percent (32/40) of the index values estimated for individual markets are "statistically significant."

Careful readers may also wonder how individual retailers, or retailers in different markets for that matter, can possibly have different levels of buying power? Remember that buying and selling prices are inextricably linked in a retailer's overall business strategy. To carry out a seasonal or periodic promotion campaign for a particular produce item, a chain, a regional office, or a group of stores must arrange to acquire more than they would otherwise typically buy. To do so, they must either raise the price that they are willing to pay, or go to other suppliers that they do not typically use. Either way, their degree of leverage is lower than usual.

This observation is also consistent with the distribution of buying staff within retail chains. If all buying were centralized, we would expect no difference among regional markets. However, McLaughlin et al. (1999) report that 30 percent of buyers are located at corporate headquarters, 45 percent in regional branches, and 25 percent in the field so 70 percent of all acquisitions originate either in regional or field offices. In summary, though the exercise of buying power in the apple procurement market is consistent and pervasive, it is often only moderately imposed.

Figure 1
Washington Red Delicious apple market power indices, 1998-99



Source: Economic Research Service, USDA.

Apple Retail Markets

In general, our results lend support to the notion of buyer collusion; firms will use similar strategies if it is tacitly recognized that this is in their shared best interests. There is, however, a considerable range in conduct parameters both within and across some of the other markets. In retail apple markets, or the consumer side of the market, the pricing index varies from 0.033 to 1.058, again interpreted in absolute value. In this case, however, the low value (the Chicago market) is an anomaly as the mean index value is 0.441 (fig. 1). Excluding this result, it is apparent that retailers exercise a greater degree of power in setting selling as opposed to buying prices. Without Chicago, over 50 percent of the retail-farm margin is due to imperfect competition. While there appears to be little effective cooperation in setting retail prices in Chicago or Los Angles, the opposite is true in Atlanta. Overall, however, only 2 of 20 parameters are not significantly different from zero, so we can conclude with some confidence that tacit cooperative pricing behavior is a least fairly typical among retail supermarket chains. There appears to be little relationship between market structure and the ability to set price. Much of the concern surrounding the recent wave of retail mergers focuses on this connection between structure and conduct - the belief that markets dominated by a few, large firms provide the participants more incentive and a greater ability to collude both against consumer and supplier interests. However, the most competitive output markets are also the ones generally served by fewer retailers—Chicago (four-firm concentration ratio (CR4) of 81.6 percent in 1998 according to VNU Marketing Information *Marketscope*) and Los Angeles (CR4 = 76.4 percent). Indeed, the market dominated by the fewest retailers, Miami (CR4 = 88.2 percent), appears to be only moderately collusive and, at any rate, very similar in this respect to other markets served by more retailers. The results from our empirical model also provide other evidence of the likelihood that firms will use their ability to price strategically.

Probability of Collusion

Specifically, our model estimates the proportion of weeks during which each retailer can be described as

either "cooperative" or "punishing." In the Albany market, for example, one chain cooperates 65 percent of the time, whereas another cooperates during 47 percent of the sample weeks. Our expectation is that chains that are more likely to cooperate are those that exercise more power over price. However, this relationship appears to be quite loose in the case of apples. (This effect is more apparent in some of the other commodities.) Interpreting the probability of cooperation on its own terms, however, leads to a general conclusion that tacitly cooperative behavior in both commodity and retail markets is common, but far from perfectly coordinated in each sample period.

Consumers fare better under a market where firms engage in periodic price wars, if only to reestablish cooperation, than in a collusive market where prices, presumably, never change. This same conclusion applies to suppliers. In interpreting these results, these values do not suggest overt or conscious collusion during cooperative periods, but rather the tacit adherence to a pricing strategy whose intent is to restore order to what is perceived to be an unfavorable market.

Impact of Shipment Volumes

By modeling each pricing power index as a function of weekly shipments, we disaggregate the test for pricing power into two components: (1) a purely strategic element that captures how firms react to decisions taken by their rivals, and (2) the impact that shipment levels have on their ability to use their pricing power in commodity and retail markets. If the second component is positive, then this suggests that retailers' bargaining power is enhanced through the mechanism described by Sexton and Zhang, namely that large supplies reduce the relative bargaining power of grower-shippers. If, however, the second part is negative, then this suggests that retailers have less bargaining power when market quantities are higher. In this case, the decline in retailer bargaining power is likely due to their pre-commitments to higher quantities during promotional periods and meeting retail demands created through their produce merchandising and category management programs.

In buying activities, we find this volume effect to be negative in 13 of the 20 chain-market pairs for apples and significantly so in 10 of these. On the other hand, this parameter is never significantly positive. Although we would expect the effect of shipments on negotiating power to vary by chain and market if the source of this effect is indeed in individual retailing strategies, the evidence support the hypothesis that higher volumes are associated with a loss of retail buyer power, not a gain. In the output market, a similar result obtains. Specifically, 14 of the 20 chain-market volume relationship are negative on the retail side, and 10 of these are statistically significant, while only 2 are significantly greater than zero. This result suggests that when a retailer commits to a large volume and buys produce accordingly, he or she loses pricing power on both the buying and selling side of the market.

Summary of Apple Market Results

Retailers do exercise power over price in both buying and selling activities apples. To the extent that this behavior causes the retail-shipping point margin to be wider than it would otherwise be, both consumers and producers incur losses as a result. Whether or not this is a general result, however, requires a similar analysis be performed with data from other commodity markets.

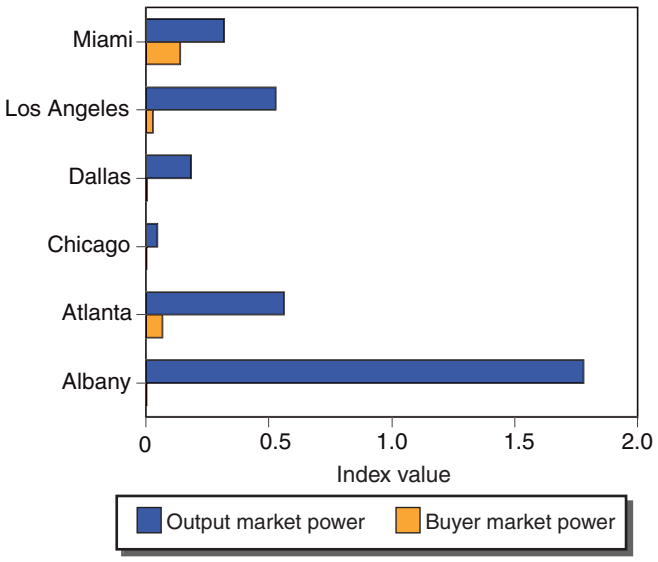
California Fresh Grapes

Due to the fact that the California grape season lasts only about 7 months, we estimate the statistical model using only 67 of the 104 weeks in our sample data set. Perhaps due to this, or the fact that some chains exhibited very little price variation at retail over the entire sample period, the model does not appear to fit the data as well as in the apple case. However, statistical tests still indicate that the trigger-price model is preferred to a static or single-regime alternative, so our approach is still preferred to the generally accepted alternative approach. On a market-by-market basis, however, the grape results are less plausible than in the apple case.

Grape Commodity Market

For grapes, 3 of the buying power indices and 2 of the output market power estimates are significantly less than zero. These estimates fall outside of the range permitted by the theory and imply that margins actually fall (either retail prices are lower or grower prices are higher) due to the strategic behavior of rival retail chains. This is not a plausible result. With this caveat in mind, however, most other markets and chains provide estimates that are plausible, and somewhat consistent with the apple results. In particular, the input market (buying) conduct parameter is statistically greater than zero in 10 of the 20 sample chain / market pairs and averages 0.040 over the entire sample (fig. 2). Miami retailers appear to exercise the most signifi-

Figure 2
California fresh table grape market power indices, 1998-99



Source: Economic Research Service, USDA.

cant buyer power. However, in each case, the degree of power is considerably less than in the apple case and, in most instances, could be argued to be not significantly different from zero in an economic sense. Even in the Miami market, the conduct parameter ranges from 0.080 to 0.292, which is only slightly off the competitive standard. These results, therefore, suggest that retailers do not exercise a significant degree of buying power in purchasing seedless green grapes, insofar as pricing behavior is concerned.

Grape Retail Market

Among retail grape markets, the estimated average index ranges from a low of 0.045 in Chicago to 1.781 in Albany, and averages 0.569 over the entire sample (fig. 2), suggesting that most of the difference between retailer and shipper prices is due to retail pricing activity in Albany. The estimate for the Albany market is suggestive of cooperative behavior, which is observed much of the time. Chains within the Atlanta and Miami markets tend to be relatively consistent in their ability to set price, whereas Los Angeles presents somewhat of an enigma. Although two chains in this market can be described as relatively cooperative in their behavior, the other two are very nearly competitive. This result is instructive, as it argues against painting all retailers with the same brush with respect to their pricing and other strategic activities. Except for one retailer, the Dallas market appears to be fairly competitive in both buying and selling fresh grapes.

Impact of Shipment Volumes

Because grapes are more perishable than the rest of our semi-storable fruits, we expect higher shipment levels to lead to higher degrees of bargaining power for retailers relative to suppliers. This would imply a significant positive parameter in the conduct parameter functions. In fact, of the 11 parameters that are statistically different from zero on the input side, 7 of these are positive. Although this evidence is not conclusive, it is suggestive that this volume effect is more prevalent than with apples. Further, of the significantly negative parameters, none are large in an economic sense.

In the output market, we hypothesize that higher levels of output are largely due to unobservable, nonprice promotion efforts such as newspapers or other store-level ads. For a given level of supply, consumers are more sensitive to price in these instances and retailers must refrain from charging a higher price. Again, this suggests a negative value for the impact of sales volumes on pricing power. From the chain-by-chain results, this occurs 9 times out of 20 and 5 of these relationship are statistically significant. Therefore, these results provide only weak support for this hypothesis.

California Fresh Oranges

For fresh oranges, we initially sought to focus only on Navel oranges in order to minimize the degree of product aggregation error that is inevitably induced in models of this type. However, the freeze of December 1998 and the seasonality of orange production meant that this focus would leave very few observations over our relatively short, 2 year time frame. Therefore, we estimate the fresh orange market power model and each of its components (supply and demand curves) with a fresh orange composite product, consisting of Navel oranges during the first part of each year and Valencia oranges for the remainder. We account for fundamental differences in these products by allowing for seasonal variation in all model components.

Including only the weeks in which fresh oranges are shipped from U.S. sources, figure 3 shows the results from using 87 weekly observations over the 1998-99 calendar years. Again, statistical tests of the trigger-price model suggest that it is preferred to the "static" alternative for each chain in every market. Thus, each chain experiences periods in which prices at both retail and the shipper level are set such that the retail-shipping point margin is at relatively cooperative levels,

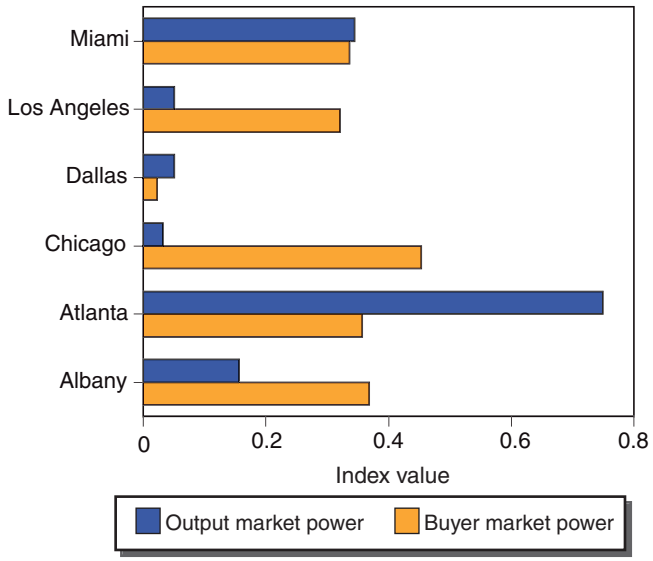
and other periods in which margins are set more competitively.

Orange Commodity and Retail Markets

Retailers in the fresh orange market appear more likely to cooperate in consumer (output) rather than in input (buyer) markets. Whereas only 8 of 20 chains appear to use considerable leverage in setting prices for raw oranges from shippers, 15 chains set significantly non-competitive retail prices - significant, that is, in a statistical sense. With respect to the retail market, the average pricing index is 0.231 and ranges from 0.032 in Chicago to 0.750 in Atlanta (fig.3). The deviation from purely competitive pricing appears to be significant in an economic sense, as well. On the input side, the extent of deviation from competitive pricing appears to be far greater than in the grape case, and similar to apples. The commodity pricing index is 0.310 for oranges, suggesting that retailer-shipper margins are roughly 30 percent wider than they would otherwise be (fig. 3). (This average is somewhat skewed by the Dallas market result, where retailers appear to possess very little ability to set price.)

It is tempting to look toward Sunkist and a few other large independent packing houses as effective countervailing forces in this market. Whereas growers of the previous two commodities (apples and grapes) tend to either sell alone, go through an independent packing shed, or form some sort of marketing alliance, fresh orange growers are more likely to belong to an organized cooperative or to supply a large, independent packing house. Therefore, with more effective supply coordination by growers, it is more difficult for retailers to exert any buying power.

Figure 3
California fresh orange market power indices, 1998-99



Source: Economic Research Service, USDA.

Impact of Sales Volume

Retailers that fail to secure sufficient quantities of fruit prior to a promotion will more likely scurry to meet demand at the last minute, thereby paying higher prices. In the output, or retail market, however, a negative relationship between sales volume and market power may also arise as promotional periods could be viewed by rivals as violations of the tacit market-sharing agreement, providing just cause for a round of punishing loss-leadership or price wars. As with table grapes, however, the orange results are mixed on this point. Only 8 of 20 chains experience a reduction in buyer power as a result of higher quantities going to market, while only 2 of 20 undergo the same effect in the output market.

Again, it is tempting to posit explanations from the trading institutions particular to this industry. Namely, the more control over supply growers and shippers have, the less likely the use of buying power as decision over the quantity shipped is more the shipper's than the retailer's. Furthermore, there is very little support for the theory that retailers' bargaining power rises with the total amount marketed of each fruit.

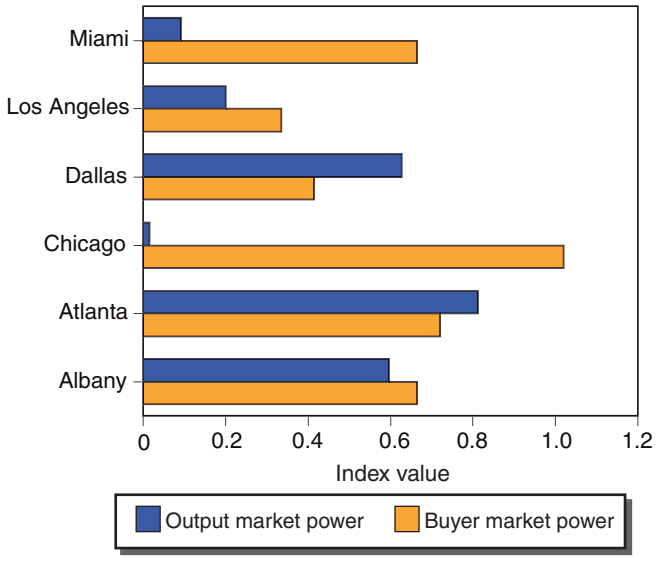
Florida Fresh Grapefruit

As with fresh oranges, grapefruit data represent a potentially heterogeneous product as different seasonal arrangements fill store shelves throughout the year. Moreover, grapefruit shipment data consist of both red and white varieties, each from a different growing region and slightly different growing season. Once again, in order to construct a reasonably continuous data set of grapefruit shipments, we define fresh grapefruits as an aggregate of both reds and whites. However, we exclude months of zero domestic shipments from the model. This avoids potential complications related to world grapefruit shipments handled by Florida shippers. In general, June, July, and August are the only months in which domestic shipments fall to zero and retailers must rely on imported product. Because consumers are able to source imported grapefruit over these months, however, we include all months in the retail model and account for any seasonal differences in demand accordingly.

Grapefruit Commodity and Retail Markets

Our analysis supports the assertion that retailers use periods of price promotion to reinforce cooperation around commonly agreed prices in two ways. First, as with other commodities, a two-regime model that describes retailers as behaving according to a trigger-price strategy does a far better job of explaining the data than a model without this feature. When there are few buyers (retailers) that sell the bulk of fresh grapefruit to consumers, (and buy from shippers), our results are highly suggestive of collusive behavior on the part of retailers. Second, strong statistical results suggest that periods of punishment occur roughly one-quarter of the time for most chains—approximately the amount of time between promotional periods. Intermittent promotions, in turn, are the mechanisms through which retailers punish, given common retailing practices that we observe for fresh produce. Our empirical analysis of the grapefruit data again indicates how close observed prices are to the "competitive ideal" in both input and output markets. Buyer power clearly exists in the majority of our sample markets (fig. 4). In fact, 12 out of 20 chain-market pairs exhibit statistically significant deviations from competitive pricing and, of these, nearly all are economically significant. Indeed, the mean pricing index on the buying side ranges from 0.330 in Los Angeles to 1.020 in Chicago, suggesting that grapefruit growers are not being paid full value for their produce. In terms of shipping-point prices, this latter result implies that prices are (almost) fully collusive in Chicago.

Figure 4
Florida fresh grapefruit market power indices, 1998-99



Source: Economic Research Service, USDA.

Although the emergence of national, centralized buying offices for the major chains may lead to an expectation that buying power is likely to be exercised upstream, the data make a stronger case for pricing power downstream. In fact, all but two of the selling indices are positive and statistically significant, indicating some degree of price setting in retail markets. Although the degree of deviation from competitive pricing appears to be quite small in Los Angeles and Miami, prices in the Dallas and Atlanta markets appear to be highly noncompetitive. Whether this is due to tacit cooperative collusion, however, is another question.

Impact of Sales Volume

Again, our hypothesis on sales volume is supported if it is found that buyer power falls in proportion to the amount of grapefruit sold in any given week. In 13 of 20 cases, this is so. In fact, deviations from this pattern - in terms of significantly positive effects of volume on buying power—occur in only three chain-market pairs and even then the estimated parameter is very small. The evidence is less strong on the output-market side as only 11 chain-market pairs exhibit significantly negative effects of volume on output market power, but again the positive parameters are uniformly very close to zero. Therefore, these results seem to bear witness that retailers' promoting of produce from time to time represents periods in which they exert less control over price in return for punishing rivals into subsequent cooperative behaviors.

Summary of Market Power Results

With respect to individual commodities, we find consistent and pervasive evidence of tacitly cooperative behavior and, hence, the exercise of buyer power for Washington Red Delicious apples. Although we cannot reject cooperative behavior among buyers of California green seedless grapes, their ability to suppress grower price does not appear to be significant in economic terms. Fresh oranges represent an intermediate case, with some retail chains demonstrating cooperative pricing practices in shipping-point markets and others not. For fresh grapefruit, the bulk of the evidence lies in support of buyer power, but there is no clear pattern among the sample markets.

In retail markets, we also find reasonably consistent evidence of imperfectly competitive pricing for apples, grapes, and grapefruit, although the extent of the deviation from perfect competition appears to be less for fresh oranges than for the other commodities. In the case of grapefruit, however, the pattern of imperfect pricing is both consistent and significant in terms of the extent of deviation from competitive pricing levels. For each of these commodities, however, there is considerable variation in price setting ability both among retailers and markets. Therefore, it is difficult to make a sweeping generalization as to the nature and extent of cooperative behavior in the fresh produce industry as a whole.

Further, in the case of apples we find that retailer price setting ability tends to decline both in buying and selling when market volume is higher. This we attribute to retail strategies that commit sellers to higher volumes during promotional periods, requiring them to either obtain favorable prices from suppliers or price more aggressively in commodity markets at the time of the promotion. This result is not consistent across commodities, however, as we find that the opposite effect - of retailer bargaining power rising with market volumes - more likely to occur in the grape market. Our hypothesis on volume is strongly supported in fresh grapefruit. On the buying side, buyer bargaining power consistently falls with the amount of produce sold. Thus retailers may embrace periods of power over price as they promote fresh produce as a means of enforcing market discipline, thus tacitly enforcing cooperation in the amount of fruit bought from growers and, ultimately, sold to consumers.